THE EFFECT OF FIRE ON LIPID COMPOSITION OF EUCALYPTS SOILS IN NORTH-CENTRAL PORTUGAL

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Wildfires as well as land management practices involving the application of fire such as prescribed fire or burning of brushwood or crop residues, affect the quality and quantity of soil organic matter (SOM) pools. The destruction of Mediterranean and Atlantic ecosystems by fire is in part caused by profound transformations of soil physical, chemical and biological characteristics, in particular the qualitative and quantitative changes in the soils' most functional soil fraction, i.e. that of organic matter (González-Pérez et al., 2004). These changes may negatively affect soil health and quality, and induce or enhance runoff generation and, thereby, the loss of soil, a non-renewable natural resource (Arias et al., 2005). This work focuses on lipid composition of SOM; a labile fraction that is prone to undergo rapid and significant changes by fire-induced soil heating. Topsoil samples (0-2cm) of eucalypt plantations - one of the prevailing and, at the same time, most fire-prone forest types in north-central Portugal - were collected at 5 occasions with roughly 6–monthly intervals, starting immediately after a wildfire in August 2010. To assess the effect of wildfire, topsoil samples were simultaneously collected in a neighbouring, long-unburnt eucalypt plantation with similar physiographical, geological and soil characteristics. The lipid fraction was Soxhlet-extracted with a dichloromethane-methanol (3:1) mixture, and its composition was determined by means of GC-MS.

The lipid fraction at 0–2 cm depth decreased sharply due to the wildfire, amounting to 2.4–5.7 % in the unburnt sample as opposed to 0.9 – 1.1 % in the burnt sample. This wildfire effect continued evident in the samples collected 24 months after the fire, in spite preliminary result indicated that the fire had been of moderate-to-high severity. The main difference in the lipid composition of the burnt and unburnt samples was that in alkyl compounds. Whereas all samples contained a homologous series of C_{18}–C_{35} *n*-alkanes, with maximum at C_{27} and C_{29}, the burnt samples revealed lower natural odd carbon preference numbers of *n*-alkane and n-alkene series as well as shorter chain lengths of the homologues series. These results agreed with those of prior work (Almendros et al., 1988). The burnt samples also showed, without exception, an accumulation of low molecular weight homologues, indicating that the fire led to thermal breakdown and cracking of long chain molecules (Fig 1).

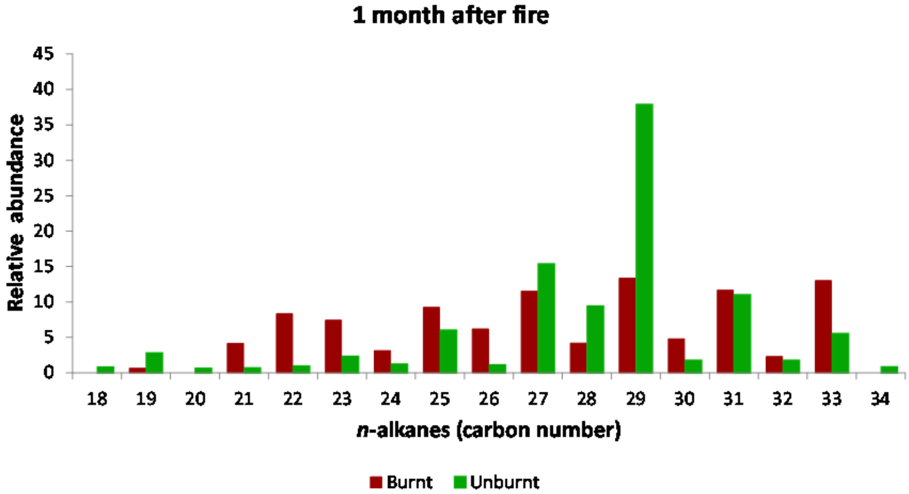

Figure 1. *n*-alkanes distribution for the fire affected and unaffected soil samples from the upper soil layer

The Fatty acids (FA) composition was particularly indicative of soil quality and its post-fire recovery. Saturated n-fatty acid bimodal series were detected in the range C_{14}–C_{30}, with pronounced maximum at C_{16} and C_{24}, suggesting a strong contribution by epicuticular waxes from vascular plants. The *n*-fatty acid series distribution also revealed marked seasonal patterns in lipid composition. The ratio of short to long chain fatty acids in the burnt and unburnt soils (pFA) indicated a strong response to the time since the fire and, therefore, might be a suitable marker for post-fire recovery. The obtained results also provided evidence for the occurrence of fire-induced oxidative scission reactions of fatty acids.

REFERENCES:

Almendros, G., Martín, F., González-Vila, F.J., 1988. Effects of fire on humic and lipid fractions in a Dystric Xerochrept in Spain. Geoderma, 42: 115– 27.

Arias, M.E., González-Pérez, J.A., González-Vila, F.J., Ball, A.S., 2005. Soil health – a new challenge for microbiologist and chemist. International Microbiology, 8: 13–21.

González-Pérez, J.A., González-Vila, F.J., Almendros, G., Knicker, H., 2004. The effect of fire on soil organic matter—a review. Environment International 30: 855–870.